## Range Safety Elements

- **Flight Safety Analysis**
- **Flight Safety Systems**
- **Flight Operations**

### THE STARS SYSTEMS

STARS is a multicenter National Aeronautics and Space Administration (NASA) proof-of-concept project to determine if operational costs can be reduced and operational flexibility increases by uses a space-based communications system to relay telemetry from reusable launch vehicles to the ground and flight termination signals form the ground to a vehicle while providing the necessary reliability and coverage. STARS can also be applied to expendable launch vehicles and unmanned aerial vehicles.

STARS is composed of two major systems: the Range Safety and Range User systems. The Range Safety system is used for Flight Demonstration #1 included a new, versatile, low-power transceiver (LPT) with multichannel capabilities coupled with a custom-built command and data handler flight processor and a commercial AshTech Z-12 C/A code Global Positioning System (GPS) receiver. The LPT received a four channel 400-bps flight termination system (FTS) link and transmitted telemetry data at 10 kbps, containing tracking data and health and status indicators for the Range Safety system. The Range User system used a broadband communications (125 kbps to 500 kbps) for voice, video, and vehicle/payload data. The launch-head command link used radar data to dynamically attenuate the transmitted signal in an attempt to have constant power at the STARS receive antenna input. NASA's Tracking and Data Relay Satellite System (TDRSS) was the space communications link.

☑ YOUR PREPAREDNESS FOR AN AUDIT OF NASA RANGE SAFETY PROGRAM REQUIREMENTS WITH THESE SAMPLE AUDIT GUIDE QUESTIONS.

### MANAGEMENT:

1. Have Range Safety Officer qualification requirements appropriate to the types of vehicles and operations at the range been established?
2. How does the Range Safety Officer ensure that all range safety flight commit criteria are satisfied prior to flight initiation?
3. What is the process for reviewing and approving vehicle program risk management plans?
4. Have range safety criteria, plans, procedures, and checklists been developed, including mission rules and flight commit criteria been established for each range operation?

### FLIGHT SAFETY ANALYSIS:

1. Has each vehicle program that involves range operations established a process for managing risk associated with vehicle flight?
2. Do all data systems that provide information used to evaluate flight safety requirements undergo validation to ensure operational readiness prior to launch?

### FLIGHT OPERATIONS:

1. Are actual conditions at the time of flight documented to verify that the flight commit criteria have been met?

NASA Office of Safety and Mission Assurance
300 E Street SW
Washington DC 20024-3210
Phone (202) 358-0521
www.hq.nasa.gov/office/codeq

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SAFETY AND MISSION ASSURANCE REQUIREMENTS

# NPR 8715.XX

# Range Safety Program

## Compliance Verification Guide

OFFICE OF SAFETY AND MISSION ASSURANCE

This brochure is intended to be used as a guide only, not as a replacement for the actual policy. To review the NASA Range Safety Program (NPR 8715.XX Draft) in its entirety, see http://www.hq.nasa.gov/office/codeq/doctree/texttree.htm.

**Objective of NPR 8715.XX**

To meet all local range safety requirements during range operations associated with flight.

# MINIMUM AUDIT POINTS FOR NPR 8715.XX

## Leadership and Management

- **Center Directors with Authority for a Range, Launch Site or Landing Site** shall coordinate with the appropriate emergency response agencies on Center Activities and potential effects on outside communities.
  - Objective Quality Evidence (OQE) – Communication Work Logs
- **Center Directors Responsible for Range Facilities**
  - Shall ensure ground range safety systems are fully operational and properly maintained.
    - OQE – Ground Range Safety System Reports
  - Shall set operational and maintenance requirements and standards for all range systems supporting range safety operations.
    - OQE – Operational and Maintenace Performance Requirements and Standards
  - Shall ensure readiness of the range system to support range safety objectives for each operation.
    - OQE – Range Safety Objectives
- **Director, Kennedy Space Center (KSC)**
  - Shall coordinate activities and actions with NASA Center range safety personnel and other entities, including Federal Aviation Adminstration and Department of Defense (DoD), to formulate, recommend, and evaluate policies, procedures, and standards.
    - OQE – Policies, Procedures, and Standards
  - Shall ensure that NASA programs use range safety practices that are consistent with applicable laws, national standards, and NASA goals.
    - OQE – Policies, Procedures, and Standards

## Core Process

- **Vehicle Program Managers** shall coordinate flight risk assessment activities with all other responsible agencies and take mitigating actions to ensure any other responsible agency's risk criteria are satisfied.
  - OQE – Flight Risk Assessment Reports
- **Range Safety Officer**
  - Shall coordinate with the Program Managers to develop range safety criteria, plans, procedures, and checklists, including mission rules and flight commit criteria.
    - OQE – Range Safety Criteria, Plans, Procedures and Checklists
  - Shall monitor the vehicle flight path/trajectory and activate the FTS when performance of the vehicle violates preplanned termination criteria or presents an unplanned, unacceptable hazard to the public, personnel, or property.
    - OQE – FTS Flight Plans

## Unique Range Policies and Requirements

- **Center Directors** shall coordinate with the Range Commanders and range organizations to ensure that the programs satisfy all requirements imposed by Goddard Space Flight Center/Wallops Flight Facility (WFF), Dryden Flight Research Center (DFRC), KSC, Space Launch Complex - 2 (SLC-2), DoD Ranges, commercial launch and landing sites, National Airspace System, or foreign ranges.
  - OQE – Specific Range Guidelines

## Range Safety

- **A Vehicle Program and the Responsible Range Safety Organization**
  - Must ensure that a flight safety analysis incorporates the elements of risk management, risk assessment, hazard containment, and risk mitigation.
    - OQE – Flight Safety Analysis
  - Must ensure that FTSs are required for all uninhabited orbital flight vehicles including every stage (motor).
    - OQE – FTS Plans
  - Must ensure that FTSs are required for each inhabited vehicle for which the mission requirements or the flight safety analysis determines an FTS is needed to protect the public.
    - OQE – FTS Plans
- **Vehicle Program Managers** shall coordinate all planning for a range operation with the responsible range safety personnel for the development of acceptable risk levels, trajectories and/or flight paths, and associated mission rules, flight commit criteria, procedures, and checklists.
  - OQE – Range Operation Planning Documentation

## Process Check

- **Vehicle Program Managers** shall implement or participate in the payload safety review process required by NASA.
  - OQE – Safety Review Reports
- **Director, KSC,** (or designee) assesses NASA Centers, component and range facilities, and programs to ensure conformance with range safety policies, procedures, and requirements.
  - OQE – Assessments, Surveys, and Staff Visit Reports

**Space Launch Initiative's Space-based Telemetry and Range Safety Project Demonstrated**

Groundbreaking developments constantly improve today's technology, and the Space Launch Initiative's Space-Based Telemetry and Range Safety (STARS) project continues the tradition by impacting the future of space travel.

"The STARS project is a critical component of KSC's strategic move into range technology development," said Jim Heald, Spaceport Engineering and Technology director. "The engineering and program management inherent in the STARS project is a testament to the innovative skills of the KSC workforce."

Unlike present methods, STARS will demonstrate the capability of a space-based platform to provide Range Safety and Range User support for a variety of launch vehicles. "STARS will help prove the concept of a space-based range," said Heald. "Space-based ranges are critical to reducing the high cost of maintaining older ground based, down range infrastructure."

Range Safety support includes flight termination processing from both space and ground assets and vehicle tracking utilizing the Global Positioning System (GPS) satellites. Range User support includes high return link data rates for voice, video and vehicle data.

STARS will demonstrate, in flight, the ability to provide vehicle position tracking data during over-the-horizon flight operations. It will also determine feasibility of forward and return satellite links for real-time monitoring. STARS will use existing, proven satellite systems such as TDRSS and GPS to provide reliable communications and minimize flight demonstration risk.

As a result of the streamlining, STARS plans to reduce the cost of delivering payload to orbit by reducing ground operation costs, which sequentially supports NASA's Space Launch Initiative. According to STARS Project Manager Lisa Valencia, estimates show that using these methods could reduce costs by up to $40 million per year.

A space-based range would require less communication, manpower and maintenance costs than the current ground-based range infrastructure. Other benefits include a decreased launch turnaround time, the ability to launch multiple vehicles simultaneously and the ability to launch 2nd generation vehicles from any U.S. spaceport.

Along with KSC (the STARS' program management center), the Dryden Flight Research Center, Wallops Flight Facility, Goddard Space Flight Center, Glenn Research Center, White Sands Complex, and Marshall Space Flight Center all have project responsibilities. For example, STARS flight demonstrations are scheduled to begin at Dryden in 2003. "The project could be considered a great example of NASA Administrator Sean O'Keefe's vision of One NASA," said C&DH Lead Engineer Erik Denson.

The Space Launch Initiative is NASA's technology research and development program aimed at increasing safety and reliability and reducing the cost of a 2nd generation reusable launch vehicle. All NASA's field centers and the Air Force Research Laboratory are actively participating in the Space Launch Initiative and are vital to its success. NASA's Marshall Space Flight Center in Huntsville, Ala., leads the Space Launch Initiative for NASA's Office of Aerospace Technology.